Applies To: **1998–02 Passport – ALL****September 17, 2002**

Cylinder Head Service

BACKGROUND

In the 1998 through 2002 Passport Service Manuals, some of the information on cylinder head service, timing belt installation, camshaft gear timing, and valve adjustment is incomplete. *For complete information, use this service bulletin along with the appropriate service manual and fuel & emissions manual.*

This service bulletin covers these topics:

- Cylinder head removal (page 1)
- Cylinder head disassembly (page 2)
- Camshaft inspection (page 2)
- Cylinder head installation (page 3)
- Timing belt removal (page 3)
- Engine timing (page 3)
- Timing belt installation (page 4)
- Camshaft subgear preloading, gear timing, and camshaft installation (page 5)
- Valve adjustment (page 7)
- Valve Inspection Chart (page 10)
- Valve Shim Replacement Chart (page 11)

PARTS INFORMATION

NOTE: For additional parts you need, refer to the Parts Catalog.

Cylinder Head Cover Gaskets:

P/N 8-97170-239-1, H/C 5517909

Cylinder Head Bolts (16 required):

P/N 8-97011-998-2, H/C 4396446

Valve Shims (While 41 shims are available, the 10 sizes below will cover most valve adjustments):

Shim# (Size)	P/N	H/C
266 (2.66 mm)	8-97149-275-0	5514443
270 (2.70 mm)	8-97149-277-0	5514468
274 (2.74 mm)	8-97149-279-0	5514484
278 (2.78 mm)	8-97149-281-0	5514500
282 (2.82 mm)	8-97149-283-0	5514526
286 (2.86 mm)	8-97149-285-0	5514542
290 (2.90 mm)	8-97149-287-0	5514567
294 (2.94 mm)	8-97149-289-0	5514583
298 (2.98 mm)	8-97149-291-0	5514609
302 (3.02 mm)	8-97149-293-0	5514625

REQUIRED SPECIAL TOOLS

NOTE: For additional special tools you may need, refer to the appropriate service manual.

Flange Holder: T/N 07RAB-TB4010B

Holder Handle: T/N 07JAB-001020A

Gear Spring Lever: T/N J-42686

Universal Holder: T/N J-43041

Valve Adjuster Holder: T/N J-42689-AH

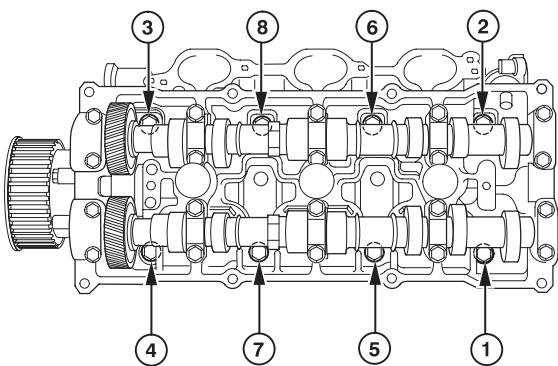
Large Binder Clip (2 required): Commercially available

CYLINDER HEAD REMOVAL

NOTE: Page references are to the 2002 Passport Service Manual and the 2002 Passport Fuel & Emissions Manual.

1. Remove the hood (see page 8F-15 of the service manual).
2. Disconnect the negative cable from the battery.
3. Remove the air cleaner (see page 6E2-543 of the fuel & emissions manual).
4. Remove the radiator upper fan shroud (see page 6B-8 of the service manual).
5. Remove the drive belt tensioner and the drive belt (see page 6B-11 of the service manual).
6. Remove the cooling fan assembly (4 bolts) and the cooling fan pulley.
7. Remove the power steering pump (see page 2A-23 of the service manual).
8. Drain the engine coolant (see page 6B-5 of the service manual).
9. Drain the engine oil.
10. Remove the crankshaft pulley:
 - Attach the flange holder (T/N 07RAB-TB4010B) with the holder handle (T/N 07JAB-001020A) to the pulley.
 - While holding the pulley with the tool, remove the pulley bolt and the pulley.
 - Install the pulley bolt. (When needed later, this will allow you to turn the crankshaft by hand.)
11. Remove the cylinder head covers (see pages 6A-19 and 6A-21 of the service manual).
12. Remove the timing belt (see **TIMING BELT REMOVAL** on page 3).

13. Remove the common chamber (see page 6A-22, steps 2 thru 8, of the service manual).
14. Remove the exhaust manifolds (see pages 6A-24 and 6A-25 of the service manual).
15. Remove the cylinder heads:
 - Loosen the head bolts in the sequence shown below.
 - Remove and discard the head bolts.
 - Remove the cylinder heads.



CYLINDER HEAD DISASSEMBLY

NOTE:

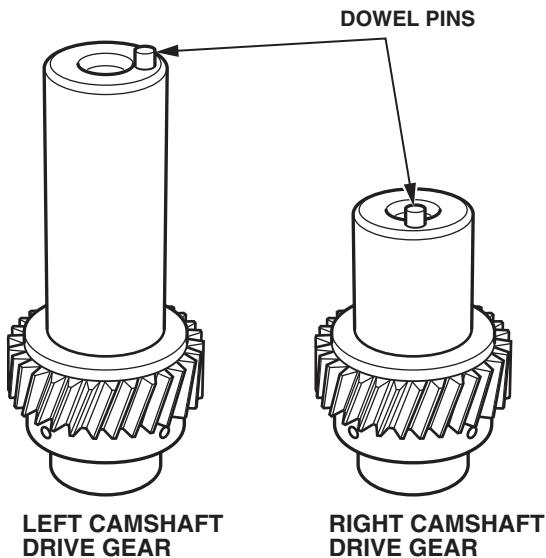
- Whether you're rebuilding a cylinder head or assembling a new one, mark the position of each camshaft bearing cap and valve train part before you remove it. When you assemble the head, install the marked parts in their original positions.
- Service manual page references are to the 2002 Passport Service Manual.

1. Remove the camshaft drive gear, camshafts, and valve train parts, as needed, for inspection or repair (see pages 6A-48 and 6A-49 of the service manual).
2. Clean the bare head to remove all varnish, carbon, and grime.
3. Check the cylinder head and gasket, and repair the head if needed (see page 6A-49 of the service manual).

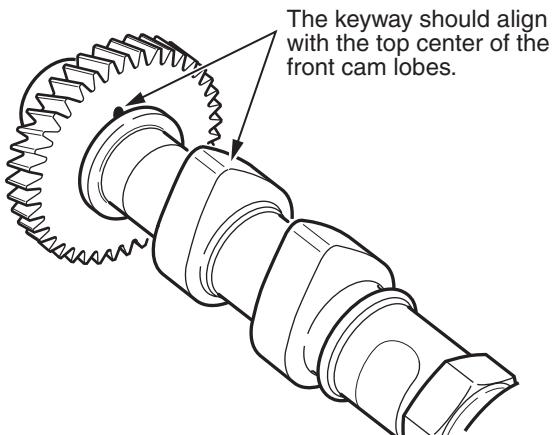
CAMSHAFT INSPECTION

NOTE: Service manual page references are to the 2002 Passport Service Manual.

1. Inspect the camshaft journal oil clearances and thrust clearances (see page 6A-62 of the service manual). If any clearances are not within specification, replace the cylinder head(s).
2. Inspect the camshaft lobe heights, journal diameters, and runout (see page 6A-61 of the service manual). If any measurements are not within specification, replace the camshaft(s).
3. If any camshaft or camshaft drive gear is seized, or if the engine is seized from other mechanical causes, inspect the camshaft drive gear dowel pins and the camshaft gears.
 - Check the dowel pins for damage, and replace the drive gear assemblies as needed.



- Inspect the camshaft gears for movement and correct positioning on the camshafts. If the gears are not stationary, or if their positions are incorrect, replace the camshaft(s).



CYLINDER HEAD INSTALLATION

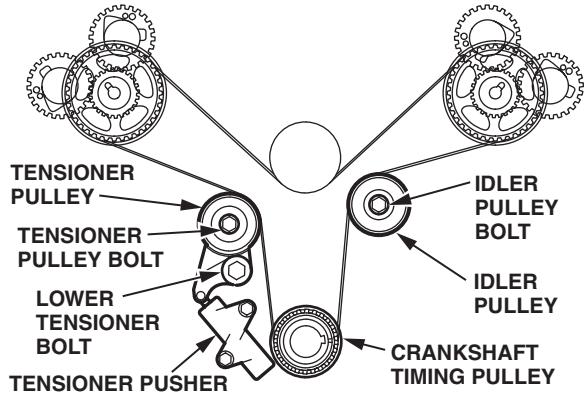
NOTE: Service manual page references are to the 2002 Passport Service Manual.

- After making the needed inspections or repairs, install the cylinder heads with new head bolts (see page 6A-34 of the service manual).
- Install all parts you removed in the reverse order of removal (see page 6A-30 of the service manual).

TIMING BELT REMOVAL

NOTE: Left and right engine callouts are from the driver's seat.

- Remove the timing belt covers in this order: right, left, then lower.
- Loosen (don't remove) the tensioner pulley bolt.

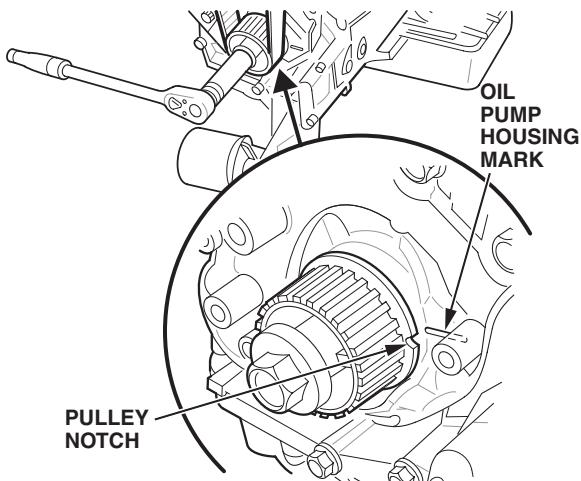


- Remove the idler pulley bolt, and let the idler pulley pivot towards the crankshaft timing pulley.
- Remove the lower tensioner bolt and the tensioner pusher.
- Carefully remove the timing belt from the pulleys.

ENGINE TIMING

- Turn the crankshaft timing pulley until its notch aligns with the mark on the oil pump housing.

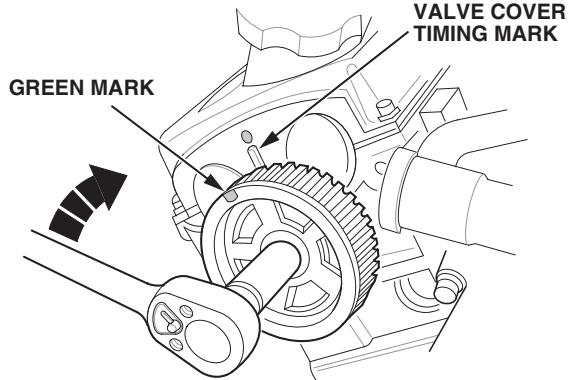
NOTE: The crankshaft timing pulley may have a green mark 180 degrees from its keyway. *Do not use this mark to set the crankshaft position.*



- Turn the right cylinder bank's camshaft pulley clockwise with a socket and ratchet. (The pulley clicks and stops several times.) Stop the pulley when its green mark aligns with the valve cover timing mark.

NOTE: You may need to rotate the camshaft pulley up to four complete turns before its green mark aligns directly with the valve cover timing mark.

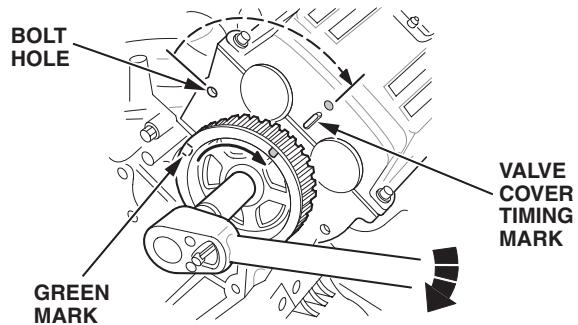
RIGHT CYLINDER BANK



- Turn the left cylinder bank's camshaft pulley clockwise with a socket and ratchet. (The pulley clicks and stops several times.) Stop the pulley when its green mark aligns with the timing belt cover bolt hole.

NOTE: You may need to rotate the camshaft pulley up to four complete turns before its green mark aligns directly with the bolt hole.

LEFT CYLINDER BANK



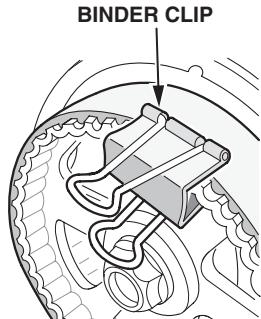
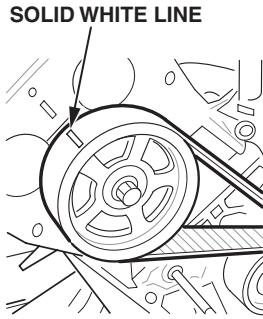
- Rotate the left cylinder bank's camshaft pulley clockwise another 1/4 turn to align its green mark with the valve cover timing mark.

TIMING BELT INSTALLATION

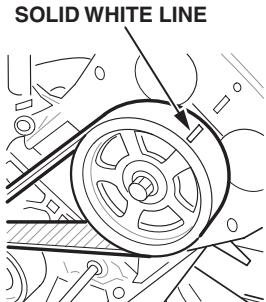
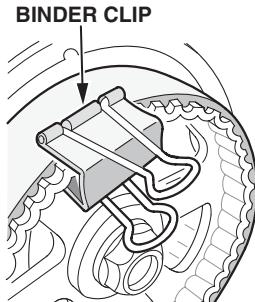
NOTE:

- Do not install the timing belt until you are sure the camshafts, camshaft pulleys, and crankshaft timing pulley are in their correct "timed" positions.
- Left and right engine callouts are from the driver's seat.

1. With the green direction arrows on the timing belt pointing clockwise, slip the belt over the right camshaft pulley so its solid white line (the line closest to the direction arrows) aligns with the mark on the pulley. Secure the belt to the pulley with a large binder clip.

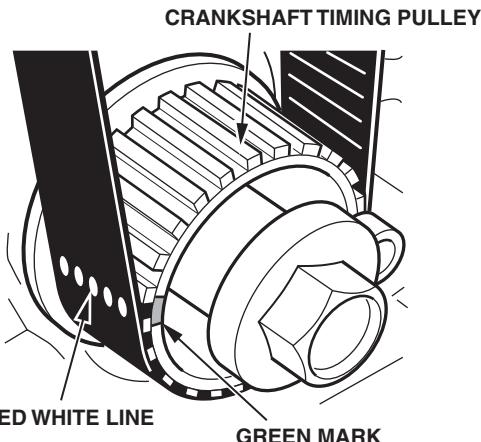


2. Wrap the timing belt around the bottom of the water pump pulley, and draw it tight.
3. Slip the timing belt over the left camshaft pulley so its other solid white line (the one farthest from the direction arrows) aligns with the mark on the pulley. Secure the belt to the pulley with a large binder clip.

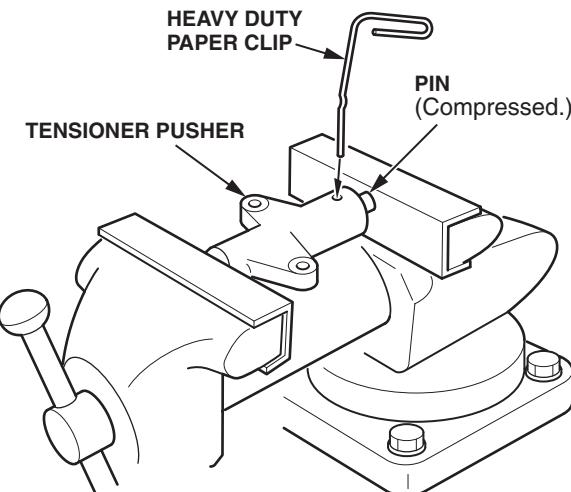


4. Wrap the timing belt around the inner side of the idler pulley, then slip the belt over the crankshaft timing pulley with its dotted white line aligned to the green mark on the crankshaft timing pulley.

NOTE: For correct belt stretch, the dotted line must meet the green mark on the crankshaft timing pulley at the 9 o'clock position. If there isn't enough slack to slip the belt over the pulley in the correct position, turn the crankshaft a few degrees counterclockwise, install the belt, then turn the crankshaft back to the 9 o'clock position.



5. Place the tensioner pusher in a soft-jawed vise, then slowly compress the tensioner pusher pin until it lines up with the two small holes in the tensioner pusher housing.

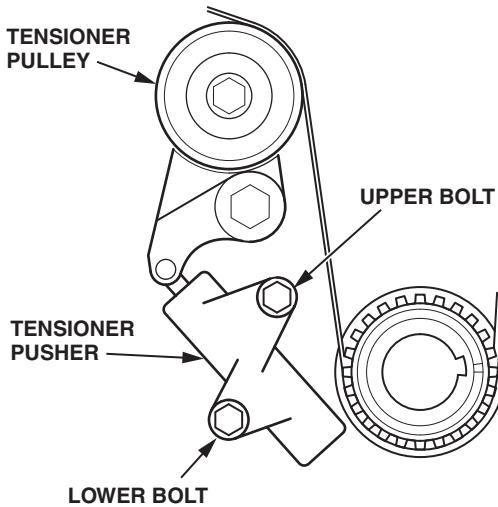


6. Insert a straightened heavy duty paper clip through the holes in the housing. This will hold the pin in its compressed position.

NOTE: A new tensioner pusher comes with its pin held compressed by a special wire. If you install a new tensioner pusher, save the wire for future use.

7. Install the tensioner pusher:

- Install the lower bolt loosely.
- Push the tensioner pusher up against the tensioner pulley, then install the upper bolt, and torque it to 25 N·m (18 lb-ft).
- Torque the lower bolt to 25 N·m (18 lb-ft).

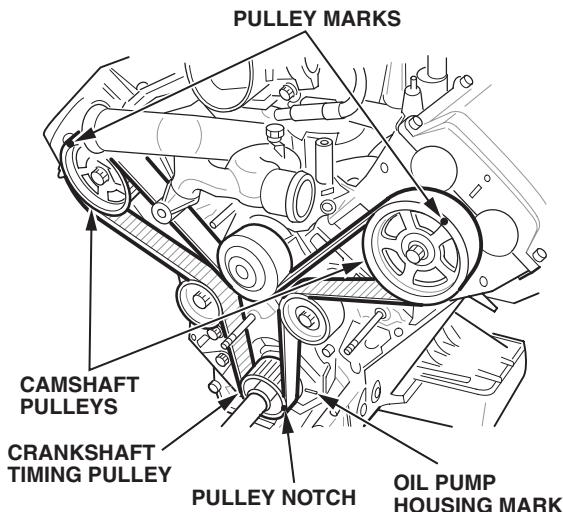


8. Remove the wire or paper clip from the tensioner pusher, and remove the binder clips from the camshaft pulleys.

9. Verify the timing belt is correctly installed:

- Rotate the crankshaft *three* complete turns (not two turns, as stated in the service manual).
- Align the crankshaft timing pulley notch with the mark on the oil pump housing.
- Check the green marks on both camshaft pulleys; they should line up with the valve cover timing marks.

NOTE: After you rotate the crankshaft, the solid white lines on the belt will not align with the camshaft pulley marks; this is normal.



10. Remove the crankshaft bolt, then install the lower, the right, and the left timing belt covers. Torque the cover bolts to 19 N·m (14 lb-ft).

11. Install the crankshaft pulley, and torque the bolt to 167 N·m (123 lb-ft).

12. Install any other parts you removed to replace the timing belt.

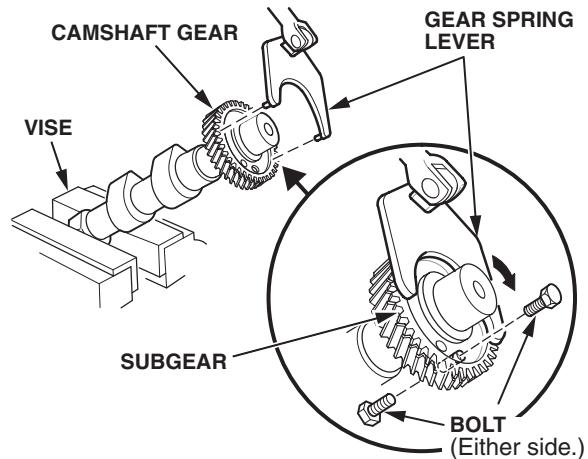
CAMSHAFT SUBGEAR PRELOADING, GEAR TIMING, AND CAMSHAFT INSTALLATION

NOTE:

- The Passport V6 engine has a “non-interference” design. This means the valves never contact the pistons, even when the valves or camshafts are not correctly timed, or even if a valve is fully open and its piston is at top dead center (TDC).
- The ratio between the camshaft drive gear and the camshaft gears is 1.33 to 1. This means the timing dots on a correctly timed camshaft will only align with the dots on the camshaft drive gears every 4th turn of the camshaft pulley.
- The left and right intake camshafts are different. On the cam lobe side of the camshaft gear, the left intake camshaft is marked “LI,” and it has dual timing dots; the right intake camshaft is marked “RI,” and it has a single timing dot.
- The left and right exhaust camshafts are the same. On the cam lobe side of the camshaft gear, both camshafts are marked “LE” and “RE,” and both have dual timing dots and a single dot.
- Service manual page references are to the 2002 Passport Service Manual.

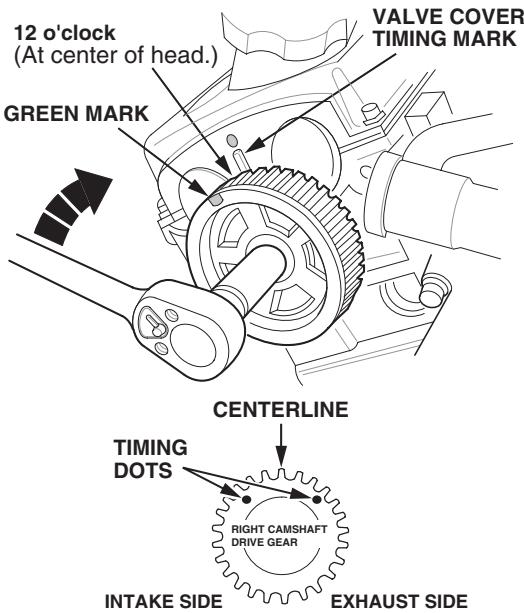
1. Before you install the camshafts, preload the subgears (preloading must be done whenever you remove the bearing caps from a camshaft):

- Make sure the spring is installed between the camshaft gear and the subgear.
- With the camshaft held in a soft-jawed vise, attach the gear spring lever (T/N J-42686) to the subgear, then turn the subgear until its threaded hole lines up with the hole in the camshaft gear.
- Lock the subgear to the camshaft gear with a 5 x 0.8 mm bolt through either side of the gear hole.
- Preload the subgears on the other camshafts.



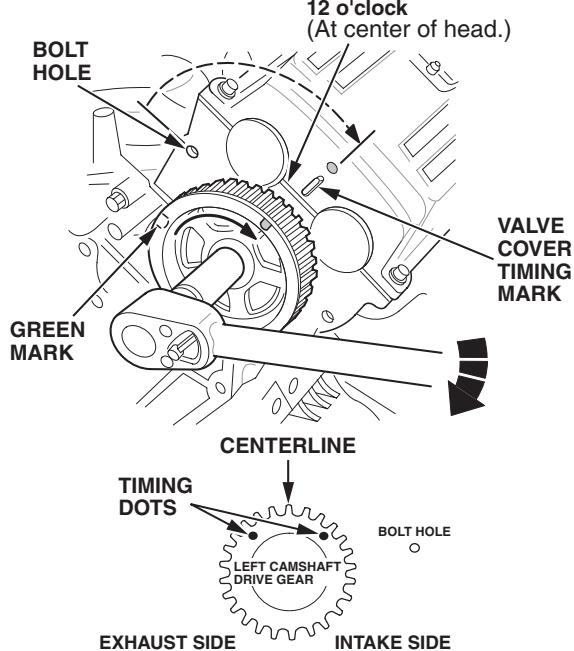
2. On the right cylinder bank, turn the camshaft pulley until its green mark is at 12 o'clock in relation to the head surface, at the center of the head. Turning the pulley brings the timing dots on the camshaft drive gear into their correct position: to the left and right of the gear's centerline.

RIGHT CYLINDER BANK



3. On the left cylinder bank, turn the camshaft pulley until its green mark is at 12 o'clock in relation to the head surface, at the center of the head. Then turn the pulley counterclockwise until its green mark points close to the timing belt cover bolt hole. Turning the pulley brings the timing dots on the camshaft drive gear into their correct position: to the left and right of the gear's centerline.

LEFT CYLINDER BANK

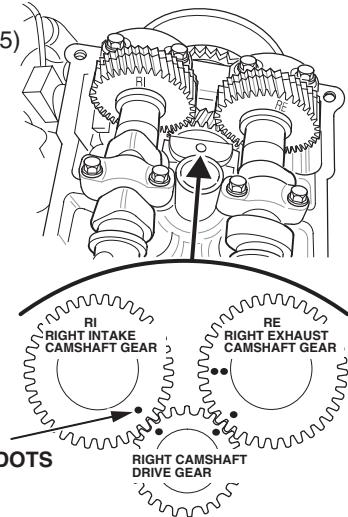


4. Install the intake and exhaust camshafts in the right cylinder bank:

- Set the camshaft marked "RI" into the intake side of the head. Make sure the single timing dot on the camshaft gear aligns with the timing dot on the camshaft drive gear.
- Set the camshaft marked "RE" and "LE," into the exhaust side of the cylinder bank, with "RE" at the 12 o'clock position. Make sure the single timing dot on the camshaft gear aligns with the timing dot on the camshaft drive gear.

RIGHT BANK

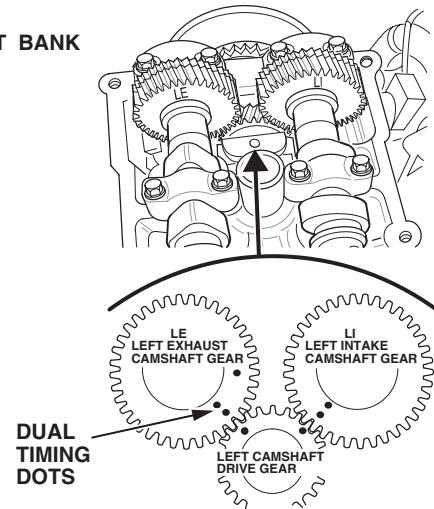
(Cylinders 1, 3, and 5)



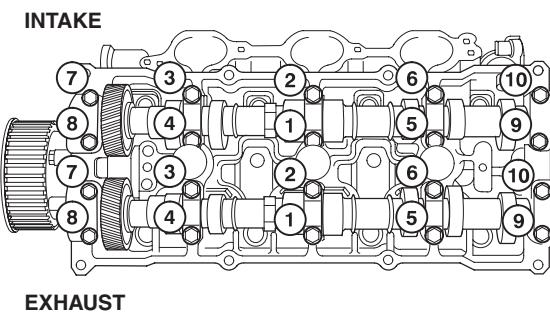
5. Install the left cylinder bank intake and exhaust camshafts:

- Set the camshaft marked "LI" into the intake side of the head. Make sure the dual timing dots on the camshaft gear align with the timing dot on the camshaft drive gear.
- Set the camshaft marked "LE" and "RE," into the exhaust side of the cylinder bank, with "LE" at the 12 o'clock position. Make sure the dual timing dots on the camshaft gear align with the timing dot on the camshaft drive gear.

LEFT BANK



- Install the camshaft bearing caps in the same locations and directions they were before you removed them.
- NOTE:** On the right cylinder bank, the directional arrows on the bearing caps should point towards the front of the engine. On the left bank, the arrows should point towards the rear of the engine.
- Install the bearing cap bolts, then torque them to 10 N·m (7 lb-ft) in the sequence shown below.



- Remove the bolts used to hold the preload of the camshaft subgears.
- If not already done, inspect the camshaft thrust clearances (see page 6A-62 of the service manual). If any clearances are not within specification, replace the cylinder head(s).

VALVE ADJUSTMENT

NOTE:

- Valve adjustment can be done either on-vehicle or off-vehicle.
- To measure exhaust valves, you need a 0.25 mm and a 0.35 mm feeler gauge.
- To measure intake valves, you need a 0.23 mm and a 0.33 mm feeler gauge. Since these are odd sizes, you may need to stack two gauges (for example, 0.11 mm and 0.12 mm to make 0.23 mm). If you do this, make sure the gauges are clean and in good condition. If you're not sure the gauge stack is correct, measure it with a micrometer.
- Service manual page references are to the 2002 Passport Service Manual.

On-Vehicle Valve Adjustment

- Make a copy of the Valve Inspection Chart on page 11.
- Make a copy of the Valve Shim Replacement Chart on pages 12 and 13, then tape the pages together, side-by-side.
- Remove the cylinder head covers (see pages 6A-19 and 6A-21 of the service manual).
- Measure the valve clearances using the Go/No-Go method (see the note below). The clearances must be
 - Intake valves: $0.28 \text{ mm} \pm 0.05 \text{ mm}$
 - Exhaust valves: $0.30 \text{ mm} \pm 0.05 \text{ mm}$

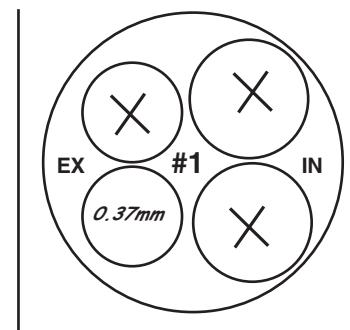
NOTE:

- To measure with the Go/No-Go method, use two feeler gauges, one to measure the smallest allowable clearance, and the other to measure the largest.
 - If the small gauge fits and the large gauge doesn't, the valve adjustment is OK.
 - If the small gauge doesn't fit, or if the large gauge slides easily, the valve needs adjustment.
 - The feeler gauges slide through the clearance gap at a slight angle, making the drag a little more than it would be on other engines.

- For valves with the correct clearance, draw an "X" in the appropriate circle on the Valve Inspection Chart. For valves with incorrect clearances, write down the clearance you measured in the circle.

VALVE INSPECTION CHART

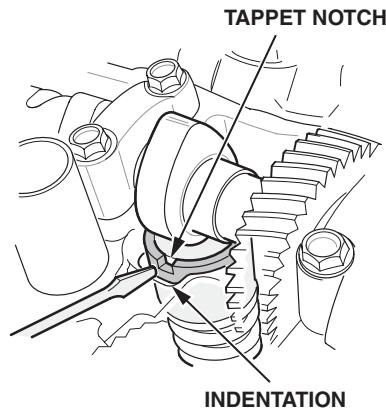
Example for #1 Cylinder



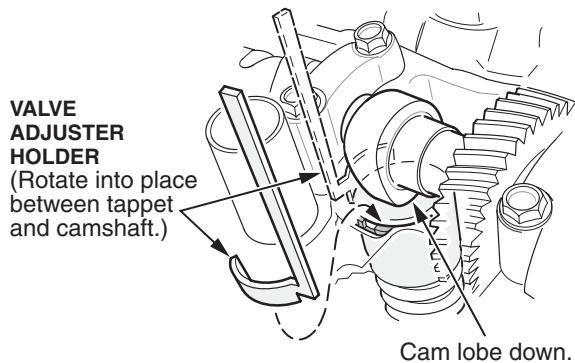
In this example, the clearance of the front exhaust valve is incorrect (0.37 mm). The clearance of the other three valves is OK.

- If you need to replace a valve shim, turn the crankshaft (or camshaft) until the cam lobe for the valve points away from the valve.

- Turn the valve tappet with a pick or a small screwdriver until the tappet notch is within the indentation in the head.



- Turn the crankshaft (or camshaft) pulley clockwise until the cam lobe presses the valve fully open.
- On the tappet side closest to the bearing cap, insert the valve adjuster holder (T/N J-42689-AH) between the camshaft and the tappet. The tool should rest on the edge of the tappet without touching the shim.

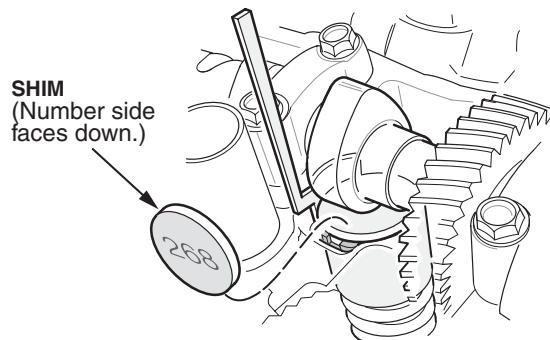


- Slowly turn the crankshaft (or camshaft) pulley counterclockwise so that when the valve closes, the tool catches between the camshaft and the tappet, holding the valve slightly open.

NOTE: *Do not turn the crankshaft (or camshaft) pulley too far or in the wrong direction. If you do, you might break the tool, or worse yet, damage the cylinder head.*

- Insert a pick or a small screwdriver into the tappet notch, and pry out the shim.
- Wipe off the shim, then write its number on the Valve Inspection Chart for that valve and cylinder. If there is no number on the shim, measure its thickness with a micrometer, and write down the measurement on the Valve Inspection Chart.
- Follow the directions on the Valve Shim Replacement Chart to select the correct shim.

- Insert the correct shim, number side down, into the tappet. Make sure the shim is fully seated.



- Release and remove the tool by turning the crankshaft (or camshaft) pulley clockwise.
- Turn the crankshaft (or camshaft) pulley clockwise until the cam lobe again points away from the valve.
- Recheck the valve clearance using the Go/No-Go method (see step 4).
 - If the clearance is OK, repeat steps 6 thru 17 for the other valves needing adjustment.
 - If the clearance is still incorrect, repeat steps 6 through 17 until it is correct, then adjust the remaining valves.
- Turn the camshaft pulleys until the single timing dot (right cylinder bank) and dual timing dots (left cylinder bank) align with the single timing dots on the camshaft drive gears.
- Install the cylinder head covers *with new gaskets* (see pages 6A-20 and 6A-21). Torque the cover bolts to 9 N·m (6.5 lb-ft).

Off-Vehicle Valve Adjustment

- Make a copy of the Valve Inspection Chart on page 11.
- Make a copy of the Valve Shim Replacement Chart on pages 12 and 13, then tape the pages together, side-by-side.
- Measure the valve clearances using the Go/No-Go method (see the note below). The clearances must be
 - Intake valves: $0.28 \text{ mm} \pm 0.05 \text{ mm}$
 - Exhaust valves: $0.30 \text{ mm} \pm 0.05 \text{ mm}$

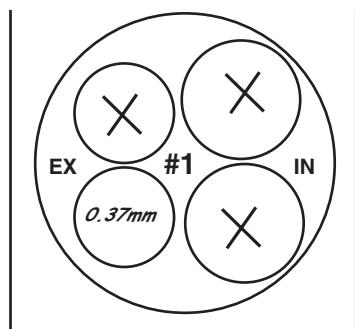
NOTE:

- To measure with the Go/No-Go method, use two feeler gauges, one to measure the smallest allowable clearance, and the other to measure the largest.
 - If the small gauge fits and the large gauge doesn't, the valve adjustment is OK.
 - If the small gauge doesn't fit, or if the large gauge slides easily, the valve needs adjustment.
- The feeler gauges slide through the clearance gap at a slight angle, making the drag a little more than it would be on other engines.

4. For valves with the correct clearance, draw an "X" in the appropriate circle on the Valve Inspection Chart. For valves with incorrect clearances, write down the clearance you measured in the circle.

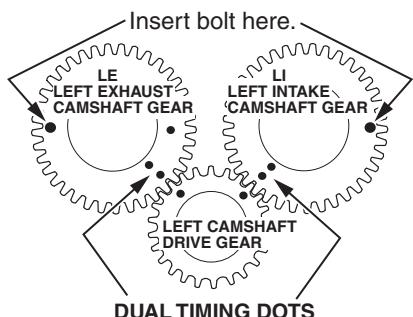
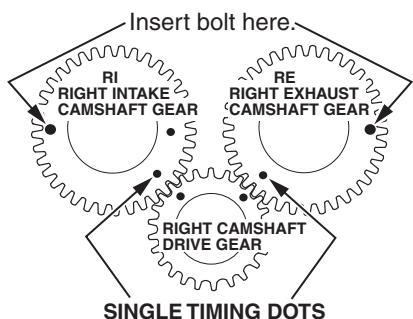
VALVE INSPECTION CHART

Example for #1 Cylinder



In this example, the clearance of the front exhaust valve is incorrect (0.37 mm).
The clearance of the other three valves is OK.

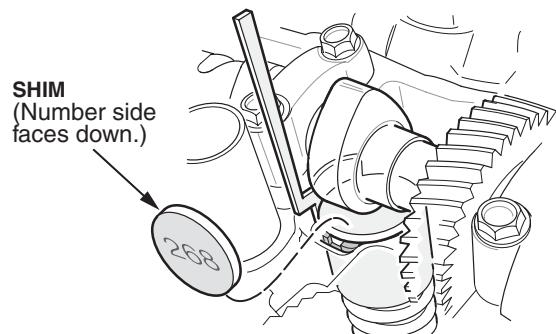
5. Rotate the camshaft pulley until the dual timing dots (exhaust camshaft) and single timing dot (intake camshaft) align with the timing dots on the camshaft drive gear.
6. Lock the camshaft gear to its subgear with a 5 x 0.8 mm bolt through either side of the hole in the gears. This holds the spring-loaded subgear in place so you can remove the camshaft. Do this for each camshaft you need to remove.



7. Remove the camshaft bearing caps, noting the location and direction of each cap.
8. Remove the camshaft(s).

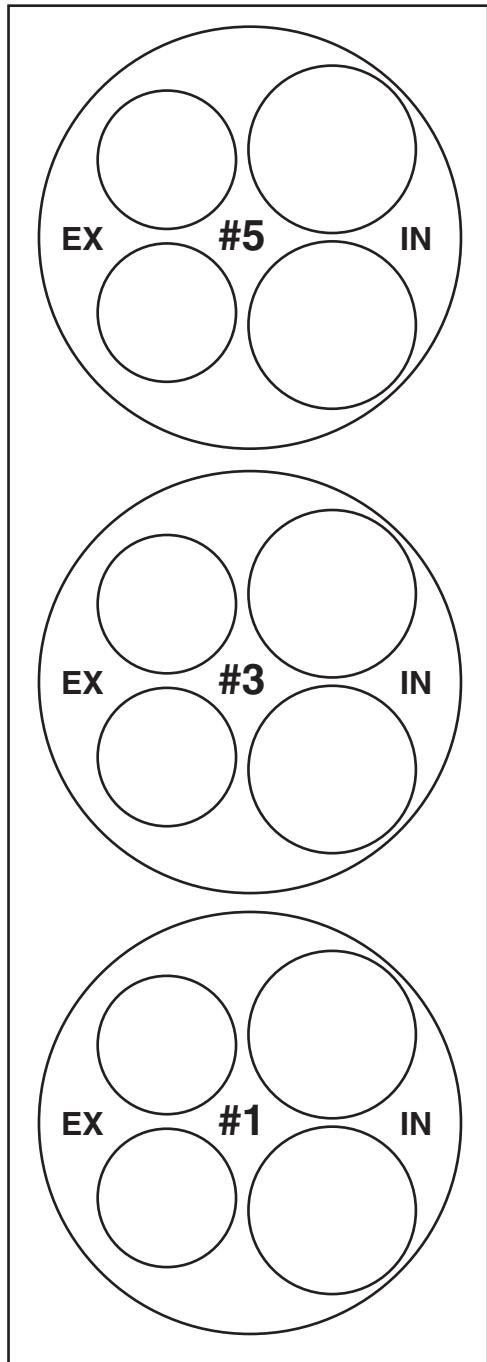
9. For each valve needing adjustment, do steps 10 thru 13.

10. Insert a pick or a small screwdriver into the tappet notch, and pry out the shim.
11. Wipe off the shim, then write its number on the Valve Inspection Chart for that valve and cylinder. If there is no number on the shim, measure its thickness with a micrometer, and write down the measurement on the Valve Inspection Chart.
12. Follow the directions on the Valve Shim Replacement Chart to select the correct shim.
13. Insert the correct shim, number side down, into the tappet. Make sure the shim is fully seated.

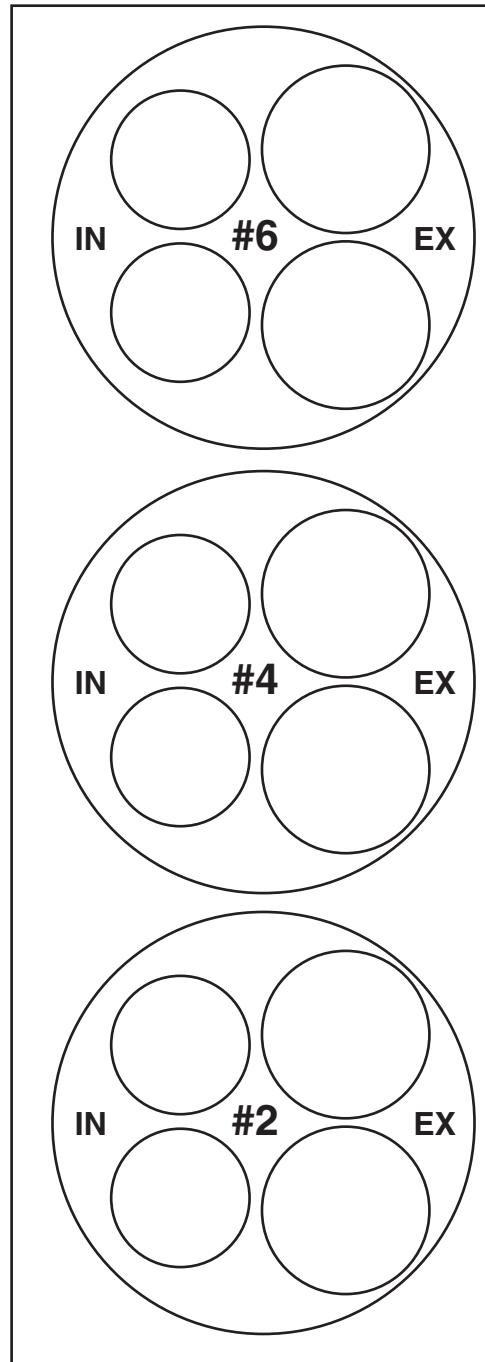


14. Install the camshafts (see steps 2 thru 9 of CAMSHAFT SUBGEAR PRELOADING, GEAR TIMING, AND CAMSHAFT INSTALLATION).
15. Rotate the camshaft pulleys a few turns to ensure the new shims are fully seated.
16. Recheck the clearances of the valves you adjusted with the Go/No-Go method (see step 3). If any clearances are incorrect, readjust them.

VALVE INSPECTION CHART



Right Cylinder Bank



Left Cylinder Bank

FRONT OF ENGINE

Directions: Check the clearance of each valve (12 intake and 12 exhaust). If a valve's clearance is correct, draw an "X" in the circle that represents that valve. If its clearance is incorrect, measure the actual clearance, and write the number in the circle for that valve.

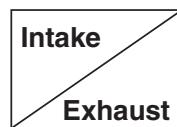
NOTE: Left and right cylinder bank designations are from the driver's seat.

VALVE SHIM REPLACEMENT CHART

Measured Clearance

Shim Removed
Example:
#268 shim removed →

	0.00	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26
240														
242														240
244														240
246														244
248														242
250														246
252														244
254														250
256														252
258														254
260														256
262														258
264														262
266														264
268	240	242	244	246	248	250	252	254	256	258	260	262	264	266
270	242	244	246	248	250	252	254	256	258	260	262	264	266	268
272	244	246	248	250	252	254	256	258	260	262	264	266	268	270
274	246	248	250	252	254	256	258	260	262	264	266	268	270	272
276	248	250	252	254	256	258	260	262	264	266	268	270	272	274
278	250	252	254	256	258	260	262	264	266	268	270	272	274	276
280	252	254	256	258	260	262	264	266	268	270	272	274	276	278
282	254	256	258	260	262	264	266	268	270	272	274	276	278	280
284	256	258	260	262	264	266	268	270	272	274	276	278	280	282
286	258	260	262	264	266	268	270	272	274	276	278	280	282	284
288	260	262	264	266	268	270	272	274	276	278	280	282	284	286
290	262	264	266	268	270	272	274	276	278	280	282	284	286	288
292	264	266	268	270	272	274	276	278	280	282	284	286	288	290
294	266	268	270	272	274	276	278	280	282	284	286	288	290	292
296	268	270	272	274	276	278	280	282	284	286	288	290	292	294
298	270	272	274	276	278	280	282	284	286	288	290	292	294	296
300	272	274	276	278	280	282	284	286	288	290	292	294	296	298
302	274	276	278	280	282	284	286	288	290	292	294	296	298	300
304	276	278	280	282	284	286	288	290	292	294	296	298	300	302
306	278	280	282	284	286	288	290	292	294	296	298	300	302	304
308	280	282	284	286	288	290	292	294	296	298	300	302	304	306
310	282	284	286	288	290	292	294	296	298	300	302	304	306	308
312	284	286	288	290	292	294	296	298	300	302	304	306	308	310
314	286	288	290	292	294	296	298	300	302	304	306	308	310	312
316	288	290	292	294	296	298	300	302	304	306	308	310	312	314
318	290	292	294	296	298	300	302	304	306	308	310	312	314	316
320	292	294	296	298	300	302	304	306	308	310	312	314	316	318



Directions:

- Find the clearance that you measured along the top row of the chart and draw a line down the column.
- Find the number of the shim you removed down the left hand column of the chart and draw a line to the right along the row.
- Find the number of the correct replacement shim in the box where the two lines meet.

VALVE SHIM REPLACEMENT CHART

Example: Measured clearance
0.38mm - exhaust valve

Example:

- You measure 0.38 mm clearance on an exhaust valve.
- You remove a #268 shim.
- The correct replacement shim is a #276.